Additional Observations on *Nitella verticillata* (Characeae) from a new Locality in New South Wales*

A. T. HOTCHKISS and K. IMAHORI

HOTCHKISS, A. T., & IMAHORI, K. Additional observations on *Nitella verticillata* (Characeae) from a new locality in New South Wales. *Proc. Linn. Soc. N.S.W.* 110 (2), (1987) 1988: 187-191.

Abundant fertile material of dioecious *Nitella verticillata* (with mucus) from brackish coastal lagoon Lake Munmorah, New South Wales, permits description of monopodial male plants, antheridia, oogonia and spores, in a species heretofore known only from limited material in Western Australia, South Australia and Victoria.

A. T. Hotchkiss, Professor Emeritus, Department of Biology, University of Louisville, Louisville, Kentucky, 40292, U.S.A., and K. Imahori, Vice-President, Naruto University of Teacher Education, Takashima, Naruto-Shi, 772, Japan; *manuscript received 17 September 1986, accepted for publication 19 August 1987.*

INTRODUCTION

Nitella verticillata was first collected by Nancy Burbidge (1956, 1960), from Lake Parkeyerring, a shallow salt water lake near Wagin, Western Australia, June 5, 1933. The specimens she sent to G. O. Allen in England proved to be sterile, incomplete, and scanty.

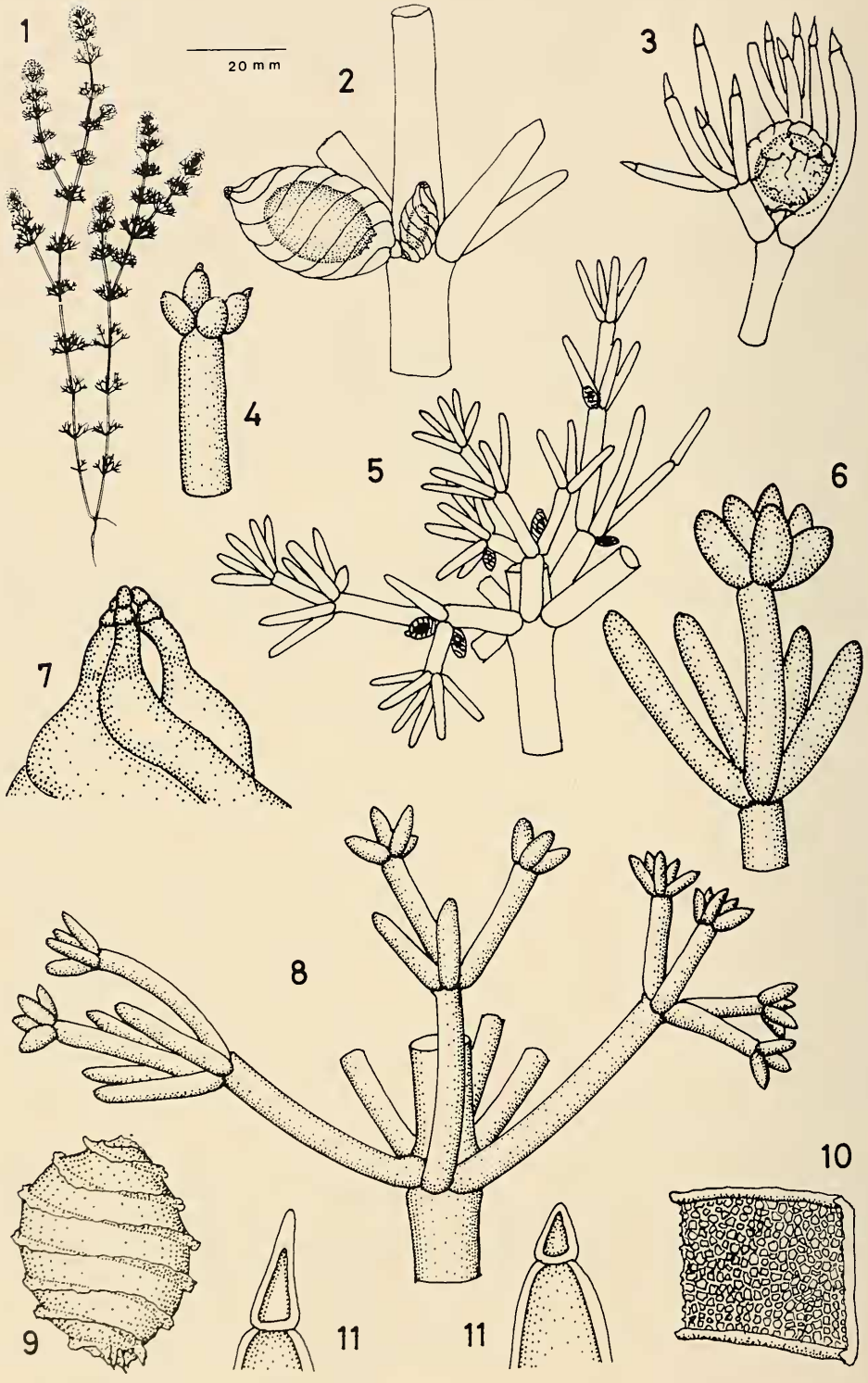
Allen sent the material to Filarszky (1937) in Hungary, who in turn described it and set it up as a monotypic genus, *Charina*, and established *Charina verticillata*. Although no gametangia were available the new species was designated monoecious.

Wood and Imahori (1964, 1965) further described and illustrated the species from the incomplete sterile specimens available from G. O. Allen, and added some details. The species was transferred at this time to the genus *Nitella* by Wood.

Wood (1972) reported finding the species in two new localities: Lake Bunijon, Victoria, and the Thorndon Park Reservoir near Adelaide, South Australia. He pointed out that the material was 'so small and threadlike' that during the course of a year collecting in Australia, he did not detect it in the field, but found it only because fragments were entangled with plants of other Characeae collected in Victoria and South Australia. The material yielded female gametangia and oospores which he described and led him to suggest that the species might be dioecious rather that monoecious. He summarized the habitat of the species in the three Australian States as follows: 'shallow water of flooded field or lake; firm bottom; fresh water, possibly tolerant of at least slight salinity'. Finally, Wood separated the new material in his key on the basis of its bicellulate dactyls, its monopodial branchlets and its small size.

In February, 1976, the first author collected *Nitella verticillata* at Lake Munmorah, north of Sydney, New South Wales. Lake Munmorah is a coastal lagoon lake with an inlet to the sea opening between sand dunes along the coast. Salinity varies with the rainfall. At the time of collecting, after an unusually rainy season with high water, the salinity level was reported to be 12.3 p.p.m. In time of drought, this varies up to 18 p.p.m. The species was found growing with *Lamprothamnium* and *Chara* species. *Nitella verticillata*

* A paper presented at the International Seaweed Symposium, Santa Barbara, California, U.S.A., August 1977.


1
20 mm
2
3
4
5
6
7
8
9
10
11
11

was growing on the flooded sandy, pebbly beaches with *Lamprothamnium* and *Chara* in deeper water nearby.

Observations

Collections: Lake Munmorah near Ashdam Creek and power plant inlet canal. A. T. Hotchkiss 76-2-24-1. Drawings made by K. Imahori, Figs 1-14.

Description: *Nitella verticillata* (Fil. et G. O. Allen ex Fil.) R. D. Wood

Plants dioecious, male and female plants similar vegetatively, bright to dark green, much branched and growing together, up to 8cm high, (Fig. 1). Axis moderately slender to 330μ in diameter: internodes as long as fertile whorl, 2-3 times as long as sterile branchlets.

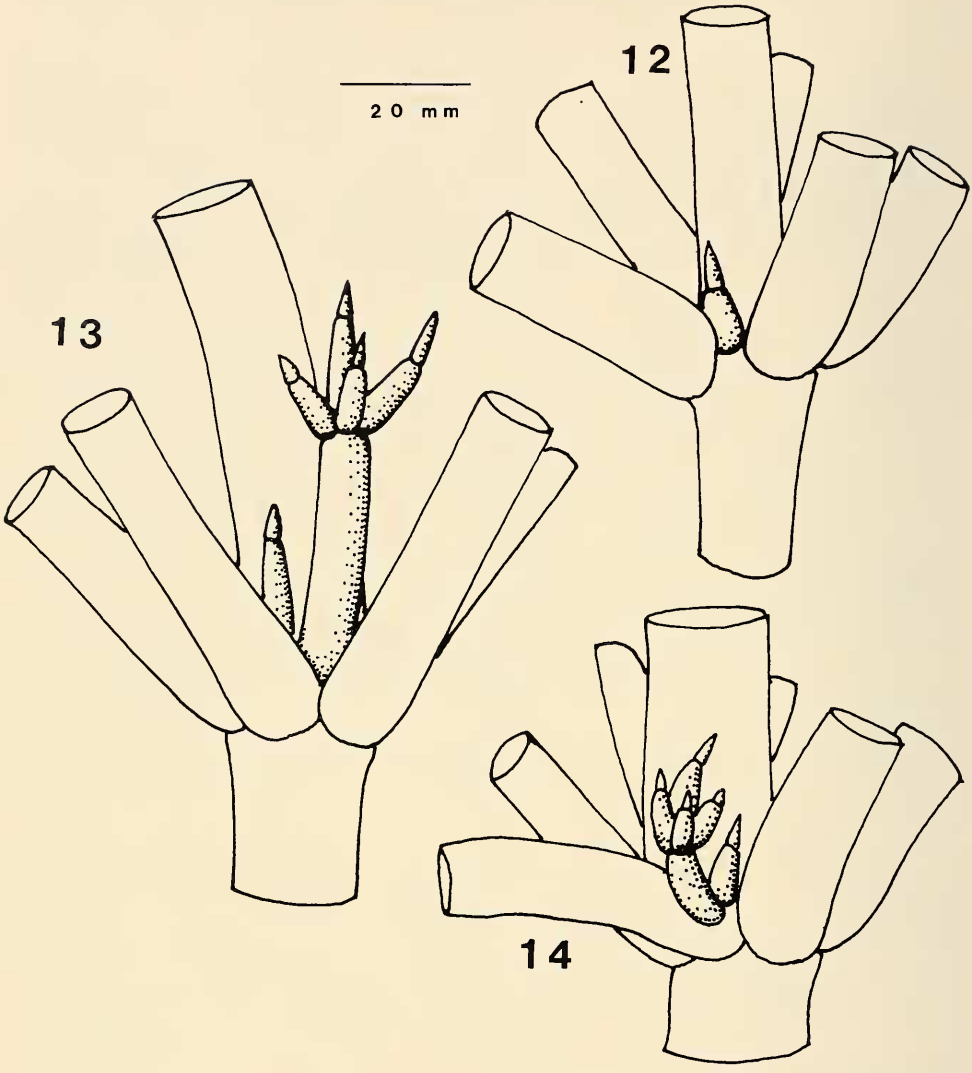
Branchlets 6-8 in a whorl, 1-3 furcated, (Fig. 5). Fertile branchlets covered with mucus and commonly congested into heads to 2mm long; primary rays ⅓ to ¼ of the entire length; secondary rays 3-4, of which 1 is usually the central ray, but absent when an oogonium or antheridium is produced terminally, and 1-3 lateral rays being dactyls usually; tertiary rays 4-6 (very rarely only 1) of which central and some lateral rays furcate once more into 4-6 terminals. Branchlet nodes on male plants commonly whorls of six lateral rays plus short central axis terminating in an antheridium which is solitary and octoscutate. Sterile branchlets somewhat diffuse (Fig. 8), 1-2 times furcated; primary rays $^2/_3$ to $^3/_5$ of the entire length; secondary rays 4-6 of which 1 is occasionally central; tertiary rays 3-4. Dactyls (Figs 4, 6), elongated on fertile branchlets and at the primary node of the sterile branchlets; abbreviated and percurrent usually at the primary node of the sterile branchlets, abbreviated and percurrent usually at the second node of fertile branchlets; uniformly 2-celled but seems unicellular because of the deciduous end cells, (Fig. 6); end cells acute or acuminate, 39-100μ wide at the base (Fig. 11).

Occasionally 1 to 4 dwarf branchlets or accessories produced at the base of sterile whorls, (Figs 12-14), 200 to 600μ long; branchlets simple (as a single dactyl) or once furcated into 3-4 dactyls.

Gametangia produced at the 1st and 2nd nodes of branchlets. Oogonia solitary or geminate, (Fig. 2), terminal or laterally produced; 550 to 580μ long (including the coronula) and 375 to 400μ wide; spiral convolutions 8-9; swollen at the base of coronula, (Fig. 7). Coronula small, 35-40μ high, 60 to 65μ wide at the base. Oospores bright to dark brown (Fig. 9); subglobose and compressed, 320 to 350μ long, 280 to 300μ wide and 180 to 200μ thick; striae prominent and flanged, 6-7; fossa 50 to 55μ; membranes (Fig. 10), bright brown, finely reticulated; 12 to 14 meshes across fossa, arranged in a line series. Antheridia (Fig. 3), solitary and terminal; stalk cell 30 to 60μ long by 30μ diameter; antheridia 250 to 330μ diameter.

Chromosome number, n = 9.

Figs 1-11. 1, Plant habit, with mucus around heads, natural size. 2, Geminate, lateral oogonia, with secondary rays surrounding central monopodial, secondary ray, x35. 3, Solitary antheridium, terminal on short, central, secondary ray, x35. 4, Short, ovoid dactyls, x35. 5, Part of a female plant showing whorl of branchlets, x15. 6, Dactyls from which the end cells have fallen off, x35. 7, Apex of oogonium, somewhat swollen at the base of coronula, x150. 8, Part of a sterile whorl of 6 branchlets, x150. 9, Oospore, with 6-7 prominent and flanged striae, x65. 10, Oospore membrane, finely reticulated, 12 to 14 meshes across fossa arranged in a somewhat linear series, x270. 11, End cells of dactyls mucronate, acute or acuminate, often deciduous, x150. (Linear scale for Figs 1-11 is 20 mm.)



Figs 12-14. Dwarf accessory branchlets, x35. 12, Non-furcating branchlet. 13, Non-furcating and once furcated branchlets. 14, Two dwarf branchlets produced between central and lateral rays. (Linear scale for Figs 12-14 is 20 mm.)

Relationships

Wood (1964, in Wood and Imahori, 1964), without benefit of gametangia, placed *Nitella verticillata* in his subgenus *Tieffallenia*, Section 8, Migularia with three other species, *Nitella struthioptila*, *N. imahorii* and *N. cristata*. The positioning was based strictly on the arrangement of the percurrent central branchlet ray, a type of branchlet found in a few other species including the *N. cristata* complex. The small *N. verticillata* with its 1-2 cell dactyls is easily separated from the larger *N. cristata* with its 3-4 cell dactyls.

A new species described by Williams (1959), *Nitella reticulata* from a coastal sand dune pond near Sydney, with its reticulate spore membrane and brackish water habitat,

is suggestive of *N. verticillata* but its dactyls, furcation and size serve to separate it from *N. verticillata*.

The *Nitella hyalina* species group, in the same subgenus *Tieffallenia*, but in Section 4, Decandollea, is often found in saline water or near coastal areas. The group has strongly percurrent branchlet axes and an abundance of mucus. However, its well-developed accessory branchlets and its much larger size separate it easily from *N. verticillata*.

The additional material provides an opportunity for further study of the position of the relatively obscure *Nitella verticillata* within the genus *Nitella* and of the importance of several key characteristics, such as the percurrent central branchlet ray. More extensive data on oogonial structure and the oospore membrane will fix its relationships more fully. In additon, the new details on antheridial structure and the arrangement of the male branchlets, enables this species to be subject to as critical analysis and comparison as any of the best known members of the Characeae.

References

Burbidge, N. T., 1956. — Robert Brown's Australian collecting localities. *Proc. Linn. Soc. N.S.W.* 80: 229-233.

——, 1960. — The phytogeography of the Australian region. *Aust. J. Bot.* 8: 75-212.

Filarsky, N., 1937. — Idigenföldi Charafélék határozása. (Determinatio Characearum exoticarum). *Magyar Tud. Akad. Mat. Term. Ert.* 55: 476-497, 6 pl. incl. 46 fig.

Williams, M. B., 1959. — A revision of *Nitella cristata* Braun (Characeae) and its allies. Part II. Taxonomy. *Proc. Linn. Soc. N.S.W.* 84: 346-356.

Wood, R. D., 1972. — Characeae of Australia. *Nova Hedwigia* 22,ii:1-120.

——, and Imahori, K., 1964. — Vol. 2. *Iconograph of the Characeae. A Revison of the Characeae.* Weinheim: Cramer.

——, and ——, 1965. — Vol. 1. *Monograph of the Characeae. A Revision of the Characeae.* Weinheim: Cramer.